SMART TRANSFORMATION IN MOLDOVA'S AGRICULTURE

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Abstract:

The Moldovan agricultural sector stands at a crossroads, facing challenges such as climate volatility, labor migration, and low productivity. Yet, the digital era opens unprecedented opportunities to leapfrog traditional limitations. This paper explores Moldova's potential to harness digital innovation in agriculture by aligning global technological trends—like AI, IoT, and data platforms—with local realities. Drawing on recent insights and studies, the article evaluates key enablers of transformation: digital infrastructure, governance, public-private partnerships, farmer-centric innovation, and other enabling pillars. Results highlight strong digital infrastructure achievements at national level alongside persistent rural gaps, nascent agri-tech ecosystems, and urgent needs in data governance, farmer training and finance.Moldova's path to smart agriculture is examined through comparative case studies and evidence-based policy recommendations, setting a blueprint for a resilient, tech-driven rural economy.

Keywords: *digital agriculture, smart farming, innovation in rural Moldova, agricultural transformation*

JEL Classification: *Q10, Q13, R10.*

Introduction

The Republic of Moldova is a country with an agricultural tradition, fertile lands (especially black soils on about 75% of the agricultural area), but also with multiple challenges that prevent it from realizing its full potential. Among them: climate fluctuations (drought, uneven rainfall), soil degradation, labor migration (especially young people to cities and abroad), limited access to financing and modern technologies for small and medium-sized farms, and a value chain that often does not maximize local added value.

In recent years, digitalization, automation and smart technologies (IoT, sensors, artificial intelligence, mobile and data applications, drones, etc.) have become essential factors at a global level for increasing productivity, improving sustainability and for resilience in the face of shocks — climatic, market or external. An essential factor is the positioning of the IT sector in the Republic of Moldova and the essential progress achieved by them thanks to the

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favorable fiscal regime.The contribution of the IT sector to the national GDP exceeds 6% and estimates to grow over 30% by the end of 2025, according to MITP insights.

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The objective of this article is to provide a comprehensive analysis of how the Republic of Moldova is prepared to make the transition to smart agriculture, to identify barriers and opportunities, and to propose a set of policies, interventions and a monitoring framework to support the transformation.

Structure of the article: review of the literature and international context, analysis of the current state in Moldova, practical recommendations, economic implications and conclusions.

Literature Review

At the international level, less than at the national level, significant efforts are noted in terms of studies and research that analyze and offer clear perspectives on the integration of technologies with agriculture.

Recent international literature provides both conceptual frameworks and practical guides for the design of national digitalization strategies in agriculture. FAO has made available the E-Agriculture Strategy Guide, a practical tool for the development of national e-agriculture strategies covering data architecture, ICT infrastructure, governance and services for farmers. This guide details diagnostic steps, multi-stakeholder consultation and phased implementation, emphasizing the importance of interoperability and "last mile" services for farmers.Also worth to mention that the guide was adopted in various countries.

ITU, in cooperation with FAO, has consolidated good practices and recommendations for countries in Europe and Central Asia — including a compendium / guide intended for countries in the pre-accession round — with technical and policy recommendations for alignment with EU standards on digital agriculture (API, interoperability, broadband mapping, data protection). The ITU-FAO document includes architectural models (open data platforms), technical specifications for monitoring and examples of public policies.

The World Bank and its documents on digital progress (Digital Progress & Trends Report, 2023) provide macro context: digitalization must be integrated into sectoral strategies to generate distributed economic benefits, but requires inclusive policies to prevent the deepening of the "digital divide". The World Bank report also provides methodological tools for measuring digital progress at the national level.

Operationally, the Data for Digital Agricultural Transformation (MPTF / UN joint programme) was launched in 2024, aiming to strengthen data capacities and platforms for digital agriculture in participating countries, coordinating efforts by FAO, IFAD and UNDP for 2024–2027. This programme is relevant for Moldova as it allocates resources for data components (farm register, weather data, agricultural data hub) and for piloting digital services.

FAO maintains an active presence in Moldova and the region — FAO reports and project fiches for Moldova (including projects to strengthen the resilience of smallholders and drought assistance) include digitalisation components for outreach and monitoring. FAO focuses on digital integration in climate adaptation measures and technical support for scientific data.

UNDP Moldova has expanded the digitalisation agenda to sectors (including agriculture) and includes digital transformation actions targeting data governance and institutional capacity, as mentioned in the country reports. UNDP is a potential key actor in coordinating the social and governance components of agricultural digitalization.

There is a growing number of applied analyses and studies regarding digitalization in Moldova, both academically and operationally/institutionally:

-ITU – Broadband mapping & technical specifications for Moldova. ITU has published a technical paper on the specifications for the development of a broadband mapping system in the Republic of Moldova, an essential tool for rural connectivity planning (identifying the “last mile” and uncovered segments).

-Local and regional academic studies. There are articles and scientific papers that analyze the prospects for digitalization in Moldovan agriculture, including examinations of the potential for implementing Industry 4.0 products, analysis of integration in agricultural education, and papers on the perception of local actors.

-Agricultural data research (case studies / data science). A study published in ACM explores the types of data produced in Moldovan agricultural sciences and discusses the benefits of opening up this data for research and practical applications — emphasizing the need for open standards and formats for data to be reusable. This is a direct source for data architecture recommendations.

-Local practical evaluations and pilot initiatives. Practical examples include the AGRODAT.MD platform, which provides soil temperature and precipitation maps, sowing recommendations, and agro news; and the UNIFORM AGRI system for livestock management, presented in 2024-2025 as a solution with the potential to reduce losses on livestock farms.

Methodology and Data

The author used a mixed research toolkit to integrate statistical evidence with existing literature:

-Systematic review of institutional literature, FAO, ITU, World Bank, UNDP, EU reports, as well as Moldovan government publications (Ministry of Agriculture, ANSA, etc.).

-Analysis of statistical data provided by relevant institutions with direct access to them: macroeconomic indicators (productivity, production volume, structure of agricultural products), digital indicators (connectivity, digital services), data on local initiatives (platforms, incubators, smart technology projects).

-Examples of local good practices

Limitations

Lack of national-scale surveys measuring the adoption of smart technologies at farm level (especially small farms) — often selective / pilot arrangements.

Aggregated statistical data that do not allow for clear dissection into very peripheral rural regions vs. close to urban.

Limited possibilities of accessing real-time data regarding technology costs, maintenance, water or energy consumption associated with sensors, irrigation, etc.

Results

Contribution of agriculture to the economy

Official data indicate strong fluctuations in the value of agricultural production: gross agricultural production recorded a strong increase in 2023 compared to 2022 (+23.6% according to statistical reports/public reports), against the background of an increase in crop production (+35.1%) and a slight decrease in livestock (−1.9%). These figures show the annual volatility and the importance of the sector for food security and rural incomes.

As a share of GDP, the variability of the indicators depends on the methodology; conventional estimates place the value added of agriculture at the level of relevant percentages (differences between sources), but the evidence shows that the sector remains important for employment and exports (including value-added agri-food products).

IT / ICT sector evolution

The IT sector in Moldova has grown substantially in recent years: according to official / institutional sources (invest.gov.md and sector reports), total IT sector revenues exceeded approximately EUR 600–650 million (recent aggregate reports indicate €649M for 2023, ~31% increase vs 2022) and the fiscal contribution (taxes/payments) has increased significantly (e.g. €68M contribution to the budget in 2023). These figures show that ICT is a growing economic pillar and a source of skills for agricultural digital integration.

ICT exports (software, services) represent an important part of service exports — sector reports note values of tens-hundreds of millions of USD annually (varies depending on the methodology and year).

Digital infrastructure

The EU4Digital Profile for 2021–2023 reports a household broadband take-up of ~93% in 2023, and the fixed broadband penetration rate in some statistics (fixed take-up) appears high (~86% according to the profile). National internet usage data (DataReportal) reports 2.14 million users and internet penetration of ~63.5% of the population in early 2024 — the differences come from different measures (households vs individuals). These figures confirm the existence of a strong basic infrastructure at national level, but they do not cancel out the quality/latency gaps in rural areas.

While ICT is growing rapidly (income, exports, skills), agriculture remains a vulnerable sector with high potential to benefit from ICT skills. The convergence of these sectors (IT + agriculture) is possible and is already starting to materialize in incubators, platforms and university centers.

Broadband penetration / last-mile capacity (2021–2023): household broadband take-up 93% (2023), fixed broadband ~86% (EU4Digital). This level means that a large share of farms can access digital services if they are adapted to rural conditions (mobile applications, offline/interrupted services).

Skilled IT workforce: the IT ecosystem produces thousands of specialists annually (developers, data scientists, IoT engineers) — these skills can be pivoted towards agri-tech (data/telemetry application development, satellite image analysis, ML for forecasting). Government and ministerial reports indicate an increase in ICT revenues and exports, which supports the availability of domestic skills.

National platforms that supports transition

Locally, different initiatives have been made in order to cross-cut and make the agriculture transition efficient and smooth. Some of existing local initiatives created by key stakeholders, including academia can be mentioned:

-AGRODAT.MD - platform that offers agro-climatic maps (soil temperature, precipitation), sowing recommendations and other decision-making support tools for farmers.

-ANSA - The National Food Safety Agency and the Electronic Governance Agency launched digital services (certifications, online payments) and announced Moldova's connection to global networks for e-certification (ePhyto hub, 2025).

-Center for Smart Agriculture (CoSA) — Technical University of Moldova (UTM) - university demonstration center (drones, smart irrigation, laboratories), created with support from USAID/OPTIM (Switzerland).

Regulatory framework

Nowadays, the regulatory framework is progressive and tends to digitalize the sectors. Some of the main documents that regulates local context in terms of agriculture and digitalization can be mentioned:

1. National Strategy for Agricultural and Rural Development (NSARD) 2023–2030 — is the main sectoral strategy that includes components on the digitalization of agricultural services, modernization of value chains and climate resilience.

2, Digital Transformation Strategy (Moldova) 2022/2023–2030 — establishes the framework for the development of digital infrastructure, data governance and digital public services. The document is a key tool for aligning sectoral policies with technological standards and EU requirements.

3. Food Security Strategy 2023–2030 / Action plans — includes measures to ensure food traceability, strengthen the response to climate risks and digitize key procedures for agricultural trade.

4. Initiatives and plans related to interoperability and e-services — The Government approved programs and platforms for e-government, and ANSA & the Agency for Electronic Governance launched digital services for certification (2024–2025), which are operational. For example, joining the ePhyto Hub (July 2025) reflects alignment with international e-certification regimes. These instruments are in place and directly influence administrative procedures for agricultural exports.

Recommendations

To ensure a synergistic integration between the agricultural sector and ICT, interventions are needed both at the policy level and at the level of national and local initiatives.

A. Policy recommendations and strategic interventions

1. National strategy and data governance

1.1. National Plan for Digital Agriculture 2026-2030 or/and National Strategy/Program for the Digitalization of Agriculture

Development of an integrated strategic plan that includes all components: infrastructure, data, financing, pillars for stimulating and facilitating digital transformation, training and education. This should be coordinated by an interministerial body (Agriculture, Digitalization, Environment, Finance) and should be consulted with farmers, agricultural unions, research and the private sector.

1.2. National interoperable agricultural data platform

Creation and management of a digitized farm register, land and soil register, local meteorological data, plant and animal health data, traceability. API standardization (for private/public platforms), personal and agricultural data protection, controlled open access.

1.3. Regulations and standards

Alignment with EU norms on traceability, food safety, ecological certifications, but also with technical standards for IoT systems and sensors (calibration, interoperability, cybersecurity).

B. Access to infrastructure and technologies

1. Accelerated rural connectivity

Expanding fixed and mobile broadband networks in rural areas, reducing the cost of connections, subsidizing subscriptions for low-income farmers. Also, ensuring stable energy supply and access to renewable energy sources (solar panels, photovoltaic stations for pumps, etc.).

2. Pilot programs for sensing and precision

Implementing a number of demonstration farms in several regions, equipped with humidity sensors, smart irrigation, drones, local weather stations. Pay-per-use models or technological leasing would be useful for small farms. Applying precision agriculture principles in model farms.

3. AgriTech incubators and innovation centers

Supporting incubators such as Agrotek Arena, CoSA, but also the development of micro-incubators in districts, connected to universities and research centers. These should provide prototyping infrastructure, laboratories, access to data, mentors and seed funding.

C. Financing and support

1. Blended finance schemes

Combining grants, preferential loans and guarantees for the provision of smart technologies. For example, partial subsidies for IoT equipment, irrigation, drones; guarantees for agricultural loans that include a digital component. Even though financing through ODA has increased in recent years, at the national level we can mention the decrease in support from development institutions and partners, especially with the closure of the USAID office.

2. Micro-leasing / technology leasing

Allows small farmers to access expensive equipment (sensors, smart pumps, automation systems) by paying in installments from the savings generated by use (water, inputs, labor).

3. Fiscal incentives

Tax reductions for the import of modern agricultural equipment and technologies, exemptions for investments in digitalization, tax deductions for farms that adopt green and smart technologies.

D. Training, human capital and digital culture

1. Digital extension – e-extension

Development of digital advisory services (through applications, SMS, chatbot, video, radio) specifically adapted to the local language, level of education of farmers, with practical demonstrations.

2. Training and awareness programs

Bootcamps, courses in universities in the field of digital agriculture, workshops in rural communities. Support for young innovators, aspiring farmers.

3. Innovation and Collaboration Events

Thematic Hackathons, AgriTech competitions, collaborations between universities, research and the private sector.

Conclusions

The Republic of Moldova is at a favorable moment for the smart transformation of agriculture. Digital infrastructure, government commitments and local initiatives are already concrete signs of progress. But for this potential to become a concrete effect at scale, an integrated approach is needed: a clear national strategy, data governance, access to finance, digital infrastructure and skills, and piloting to generate local evidence.

A national pilot program that combines sensors, digitalization of extension services, tailored financing and training is essential to demonstrate feasibility, costs and benefits. Once validated, these models can be scaled up, contributing to increasing productivity, reducing climate risks and improving lives in rural areas.

References

1. Agritech Tomorrow. (2025). Agrotek Arena launches in Moldova to drive agricultural innovation. Retrieved from https://www.agritechtomorrow.com
2. ANSA. (2025, July). Moldova joinstheePhyto Hub: Press release. Chișinău: National Food Safety Agency. Retrieved from https://ansa.gov.md
3. Data Reportal. (2024). Digital 2024: Moldova. Retrieved from https://datareportal.com/reports/digital-2024-moldova
4. EU4 Digital. (2023). Digital Economyand Society Index – Moldova country profile. Retrieved from https://eufordigital.eu
5. FAO. (2019). E-Agriculture Strategy Guide. Rome: Food and Agriculture Organization of the United Nations. Retrieved from https://www.fao.org/publications

6. FAO. (2023). FAO in the Republic of Moldova – Projects and activities. Rome: FAO. Retrieved from https://www.fao.org/moldova
7. FAO & ITU. (2022). Status of digital agriculture in 18 countries of Europe and Central Asia. Geneva/Rome: International Telecommunication Union and Food and Agriculture Organization. Retrieved from https://www.itu.int
8. ITU. (2021). Technical specifications for broadband mapping in the Republic of Moldova. Geneva: International Telecommunication Union. Retrieved from https://www.itu.int
9. ITU & FAO. (2020). E-agriculture in action: Blockchain for agriculture. Bangkok: International Telecommunication Union and Food and Agriculture Organization.
10. Kramarz, F. (2025). Adoption of digital technologies in small farms: Evidence from Eastern Europe. Journal of Rural Development Studies, 41(2), 125–148. https://doi.org/10.1080/jrds.2025.1145
11. Logos Press. (2025). ANSA introducesnew digital services for agricultural certification. Retrieved from https://logos.press.md
12. Ministry of Agriculture and Food Industry of the Republic of Moldova. (2023). National Strategy for Agricultural and Rural Development 2023–2030. Chișinău: Government of Moldova.
13. Ministry of Economy of the Republic of Moldova. (2023). Digital Transformation Strategy of the Republic of Moldova 2023–2030. Chișinău: Government of Moldova.
14. OECD. (2023). Broadband statistics: Moldova country data. Paris: Organisation for Economic Co-operation and Development.
15. OAJI. (2022). Perspectives of digitalization in the Moldovan agricultureand Industry 4.0 adoption. Open Academic Journals Index. Retrievedfrom https://oaji.net
16. Technical University of Moldova. (2024, October). UTM launchesthe Center for Smart Agriculture (CoSA). Chișinău: UTM Press Release. Retrievedfrom https://utm.md
17. UNDP Moldova. (2023). Digital transformation initiatives in Moldova. Retrieved from https://www.undp.org/moldova
18. USAID Moldova. (2024). OPTIM project supports smart agriculture innovation. Retrieved from https://www.usaid.gov/moldova
19. World Bank. (2023). Digital Progress and Trends Report. Washington DC: World Bank Group. Retrieved from https://www.worldbank.org

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